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MADROÑO

A WEST AMERICAN JOURNAL OF BOTANY

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NOTES ON THE FLORA OF GUADALUPE ISLAND, MEXICO

Reid Moran

Guadalupe Island lies 250 miles south of San Diego, California, and 160 miles off the coast of Baja California, Mexico. Since the flora of Guadalupe Island is related to that of California and especially to that of the Californian islands, a former land connection to the north has been suggested. But the island is volcanic in origin and is now separated from the mainland by depths of more than 2000 fathoms: it probably has never been connected with other land areas.

Two monotypic genera, *Baeriopsis* and *Hesperelaea,* are endemic to Guadalupe Island; and two other groups sometimes treated as genera, *Nesothamnus* and *Petromecon,* are also endemic. Of the 151 species of vascular plants that probably are native, about 34 species, or 22.6 per cent, are endemic. An additional 17 species, or 11.3 per cent, are insular endemics, mostly recurring on the Californian islands to the north. The number of endemics of course cannot be exactly stated without an evaluation of each species.

Eastwood (1929) summarized botanical explorations of Guadalupe Island up to that time and listed the species collected. The only additions since published are by Howell (1942).

In April of 1948, George Lindsay and I visited Guadalupe Island with Mr. and Mrs. Lewis Cavanagh in their ketch, the *Marviento* (Moran and Lindsay 1950). We collected at Northeast Anchorage, at the pine grove, and at the south end—all localities previously visited by several botanists. In addition, we collected on Outer Islet, whose flora has not been reported before. George Lindsay again collected on Outer Islet on January 27, 1950.

Outer Islet is a volcanic crater about two miles south of the main island. Cliffs 400 feet or more in height rise sheer from the sea to the crater's rim. Only on the north side, where the rim dips lowest, do the vertical cliffs give place to a scalable slope; and here, too, a small cove gives some shelter against the western swell. Within the crater, a few feet below the low point of its rim, is a flat floor of alluvium perhaps two acres in extent, sparsely covered with low vegetation. From this floor the inner slopes of the crater rise rather uniformly at about 45°. An irregular network of crevices, dividing the surface into large plates, gives foothold to more low-growing plants.

Though Outer Islet is rather barren and has little variety of habitats, it is at least free from the plague of goats which on the main island has reduced many species of plants nearly or quite to extinction. In our brief time on Outer Islet, we found 30 species of plants. Two were undescribed and five others were previously

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unreported from Guadalupe Island. Ten (including the new species) are known only from Guadalupe Island, and seven others are insular endemics. Because of the goats, several of these species probably are now rare if not extinct on the main island.

The first set of my specimens is in the Dudley Herbarium of Stanford University (DS). Field numbers are mine unless otherwise indicated. George Lindsay's specimens are at the San Diego Museum of Natural History.

Plants of Outer Islet

Dichelostemma pulchellum (Salib.) Heller. Infrequent on the inner slope (*2936*).

Atriplex Barclayana (Benth.) Dietr. Common on the inner slope and floor of the crater (*2929*).

A. californica Moq. North outer slope (*2946*).

Eriogonum molle Greene. Occasional on the inner slope, but without flowers (*2927*). Previously known only from Cedros Island, Baja California.

Mirabilis laevis (Benth.) Curran. Occasional on the inner slope (*Lindsay 1815*).

Mesembryanthemum crystallinum L. Common on the crater floor.

Talinum guadalupense Dudley. Common on the crater floor, just coming into leaf and flower (*2942*). Also abundant on a black lava rock about 100 yards offshore and easterly of the southernmost point of the main island (*2867*). An exact locality for this plant has not previously been given. Although originally described as rhizomatous, it is a succulent shrub about 5 dm. high. For photographs and a description, see Moran and Lindsay 1950.

Spergularia macrotheca (Hornem.) Heynh. Occasional on the inner slope (*2928*).

Eschscholzia Palmeri Rose. A few plants on the north outer slope (*2945*).

Erysimum insulare Greene. Occasional on the inner slope (*2935*). Previously known only from San Miguel and Santa Rosa islands, California.

Dudleya guadalupensis, sp. nov. Caudex diametro 1½–3½ cm. multiramosus, rosulae foliis 35–75 oblongo-oblanceolatis apiculato-acuminatis 2½–6½ cm. longis 8–13 mm. latis, caulibus floriferis sinuosis 2–3 dm. longis, calycis tubo 1–1½ mm. longo, petalis lineari-lanceolatis acutis 11–13 mm. longis 2–2½ mm. latis basi 1–2 mm. connatis valde carinatis fere rectis adscendentibus sed non vere erectis inter se non contingentibus, carpellis suberectis sed separatis maturis adscendentibus.

Caudex 1½–3½ cm. thick, becoming 10 cm. or more long, branching to form rounded clumps of 60 or more rosettes; rosettes subglobose, 3–6 cm. in diameter, of 35–75 leaves, the outer leaves erect or somewhat incurved over the inner; rosette

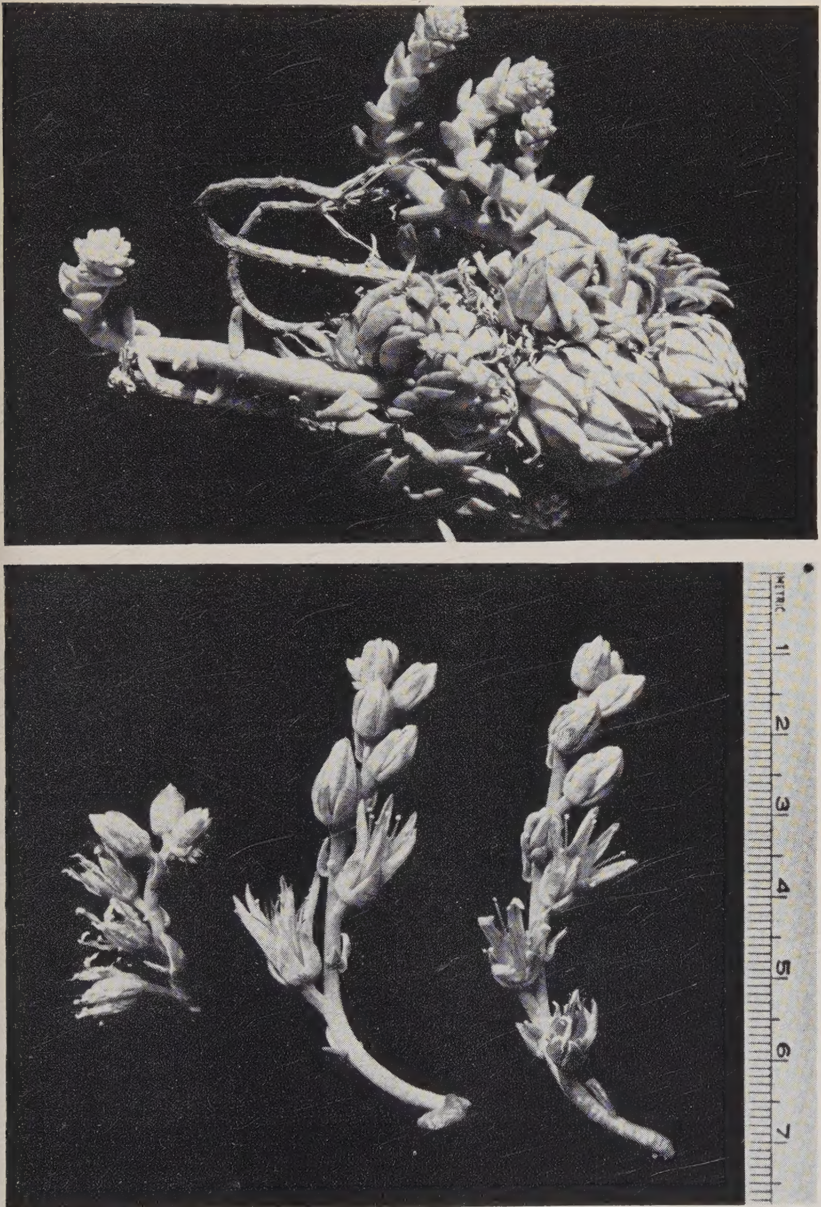

Plate 3. Dudleya guadalupensis, Above: Rosettes with young floral stems and remnants of old ones; photographed April 18, 1948, two days after collection. Below: Cincinni produced by detached floral stems; photographed June 22, 1948.

leaves not glaucous, oblong-oblanceolate, apiculate-acuminate, 2½–6½ cm. long, 8–13 mm. wide, 2–3 mm. thick, the base 4–8 mm. wide, the margins rounded; floral stems glaucous, sinuous, 2–3 dm. long, 4–7 mm. thick, with about 15–35 leaves, leafless in the lower 5 cm.; cauline leaves glaucous, ascending, triangular-ovate, acute, the lowermost 1–2 cm. long, 7–10 mm. wide; inflorescence glaucous, of 2–3 ascending simple or bifurcate branches, the cincinni 4–8 cm. long, with 7–12 flowers; pedicels erect, the lower 3–5 (–8) mm. long, the upper 2–3 mm. long; calyx 5–6 mm. wide, 6–8 mm. high, rounded below, the tube 1–1½ mm. long, the segments narrowly triangular-ovate, acute, slightly unequal, 3–5 mm. long, 2½–3½ mm. wide; petals white, somewhat greenish along the keel, linear-lanceolate, acute, 11–13 mm. long, 2–2½ mm. wide, connate 1–2 mm., strongly keeled, nearly straight, ascending, not touching each other above the calyx, the corolla about 4 mm. in diameter at the base and 7–11 mm. in diameter above; stamens erect, with filaments about 9 mm. long, the epipetalous adnate 2–2½ mm., the antisepalous adnate 1–1½ mm.; anthers yellow, about 1 mm. long; scales whitish, 1 mm. or more wide; carpels nearly erect but separated, or bowed outward with the styles connivent, the ovaries about 4–6 mm. long, the styles at first about 2 mm. long, becoming 3–4 mm. long in the fresh material; mature follicles ascending, the ventral margins about 60–75° above horizontal. Chromosome number: $n = 17$.

Type. Outer Islet, Guadalupe Island, April 16, 1948, *Moran 2947* (DS 324267, 324268).

At the time of collection, the rosettes had about 35 to 70 leaves and were very compact, the outer leaves being tightly folded over the inner. Immature leaves less than 2 cm. long were numerous, making up about half the total number; and they were nearly equal in size rather than grading evenly from youngest to mature, as is usual in *Dudleya*. The date of collection was perhaps near the end of the growing season: probably the number of leaves was then about maximum, many of the leaves of the next season having already been formed. In cultivation in California, the rosettes look quite different. The number of leaves is about 25 to 40, the outer leaves are ascending rather than incurved, and the gradation from small to large leaves is more even. At the native locality the appearance of the rosettes doubtless varies with the season.

No species of the subgenus *Stylophyllum* has flat thin leaves like those of *D. guadalupensis*. The leaves of *D. formosa, D. Traskiae,* and *D. virens* may be quite broad relative to their thickness; but if so, they are much broader and thicker and often much longer than those of *D. guadalupensis*. The leaves of *D. guadalupensis* seem more typical of *Eududleya;* in particular, they resemble those of *D. linearis,* which is endemic to the San Benito Islands, Baja California.

The tortuous floral stem of *D. guadalupensis* seems to be unique in the genus. All plants seen, amounting perhaps to a hundred or more, showed this character in the young floral stems and in those remaining from previous seasons.

The specimens were collected about a month before the time of flowering. Young floral stems continued to develop but became somewhat etiolated before they were unpacked. The first flowers were abnormal because of etiolation, but younger buds produced flowers that appeared more normal. Plants grown at four localities in California failed to flower in 1949, 1950, and 1951. The description of inflorescence and flowers, therefore, is based upon old floral stems collected on Outer Islet and upon the fresh material of 1948, which appears to be normal, but which in some respects may not be so.

In *D. guadalupensis* the calyx tube is 1 to 1½ mm. long. In *D. rubens* apparently the tube may be 1 mm. long. But in most other species there is scarcely more than a suggestion of a calyx tube.

The petals of *D. guadalupensis* are long and narrow, ascending, strongly keeled, nearly straight, and not in contact with each other above the calyx. They are longer and relatively narrower than in any species of *Stylophyllum*. In most species of *Stylophyllum* the petals are widespreading from near the middle. In those with relatively erect petals, as also in the species of *Eududleya,* the petals are in contact with each other well above the calyx.

Thus *Dudleya guadalupensis* appears to differ from other species of *Dudleya* in its twisted floral stems and in its somewhat united sepals. It differs from *Stylophyllum* in its numerous small thin leaves in dense rosettes and in its long, narrow, straight, strongly keeled petals. And it differs from *Eududleya* in its separated petals and from most species also in its ascending predehiscent carpels.

Dr. Charles H. Uhl of Cornell University studied the type collection and found a gametic chromosome number of 17.

Lotus ornithopus Greene. Occasional on inner slope (*2924*).

Euphorbia misera Benth. Common on the crater floor and occasional on the inner slope (*2939*). Not previously reported from Guadalupe Island.

Rhus integrifolia (Nutt.) B. & H. Occasional on the inner slope and one patch on the crater floor; without flowers or fruit (*2932*). Not previously reported from Guadalupe Island.

Lavatera occidentalis S. Wats. Common on the inner slope (*Lindsay 1803, Moran 2930*). In April 1948 this was in fruit, and in January 1950 George Lindsay collected it in flower.

The species as it occurs on Outer Islet may be described as follows: herbage very sparsely stellate puberulent, only the calyx densely so; leaf blades 6–12 cm. wide, lobed about one-third of the way to the base, the lobes rounded or narrower, coarsely crenate; petioles 4–14 cm. long; petals cream-colored to pale green with deep purple veins, widespreading, 4–6 cm. long. The flowers agree well with those of previous collections from Guadalupe Island. However, the lobes of the leaves are shorter and more rounded and the puberulence is sparser.

Lavatera insularis S. Wats., of the Coronado Islands, is here referred to *L. occidentalis,* which is therefore scratched from the list of Guadalupe Island endemics. The collections seen from the Coronado Islands are quite uniform and perhaps came from one small area on the west slope of the southern island. Collections from Guadalupe Island are variable in leaf shape, but some of them closely match the specimens from the Coronado Islands. Greene (1885) said that the flowers of *L. insularis* were exactly those of *L. occidentalis,* and so it appears. There remains only the slight difference in the degree of fusion of the involucral bracts.

Lavatera Lindsayi sp. nov. Frutex circa 3 dm. altus pube stellata velutinus, foliis rotundo-cordatis 4–9 cm. latis vadose 7-lobatis, lobis rotundatis crenatis, petalis purpureis spatulatis emarginatis erectis adscendentibusve 3–5 cm. longis. Priori valde affinis sed pube densiore foliis minoribus vadosius lobatis petalis purpureis erectis differt.

Shrub about 3 dm. tall. Herbage velvety with a dense stellate puberulence. Leaf blades round-cordate with the sinus nearly closed, 4–9 cm. wide, seven-lobed one third of the way to the base or less, the lobes rounded, coarsely crenate; petioles 2–5 cm. long. Pedicels several in the upper axils, nearly equalling the flowers. Involucre 1–1½ cm. long, of 3 oblong rounded bracts united in the lower third. Calyx about 2 cm. long, divided to the middle into triangular-ovate acute or acuminate segments. Petals deep purple throughout, spatulate, emarginate, erect or slightly ascending but not widespreading, 3–5 cm. long. Fruit not seen.

Type. North outer slope of Outer Islet, Guadalupe Island, April 16, 1948, *Moran 2944* (DS 325397); distributed as *L. occidentalis.* Collected at the same place by George Lindsay (*1812*); both collections in flower.

Lavatera Lindsayi is close to *L. occidentalis,* differing in denser puberulence, smaller and more shallowly lobed leaves, and more erect purple petals. The relationship of the two is puzzling. On Outer Islet they appear quite distinct. Since they grow near together and since their flowering times overlap, the apparent lack of intermediates suggests incompatibility. Moreover, plants of *L. occidentalis* on Outer Islet are even less puberulent than other collections of *L. occidentalis* and agree with them in floral characters: thus in these respects *L. occidentalis* of Outer Islet shows no approach toward *L. Lindsayi.* These facts suggest that the two plants are best regarded as separate species. Yet it seems remarkable that of all the collections of *L. occidentalis,* those from Outer Islet most closely approach *L. Lindsayi* in leaf shape.

With regard to the difference in flower color, it may be of interest that in *L. assurgentiflora* Kell. on Indian Rock, off Santa Catalina Island, I saw (and recorded in color photographs) two color phases on adjacent plants that otherwise were essentially identical.

SPHAERALCEA PALMERI Rose. Occasional on the crater floor, without flowers or fruit (*2943*).

CROSSOSOMA CALIFORNICUM Nutt. Only one small shrub seen, on the inner slope (*2938*).

MAMMILLARIA BLOSSFELDIANA Bödeker var. SHURLIANA Gates. One specimen on the crater floor (*Lindsay 540*). Also seen at the south end of the main island. Determined by George Lindsay. This is the plant reported from Guadalupe Island as *M. Goodridgei* Scheer.

LOMATIUM INSULARE (Eastw.) Munz. Occasional on the inner slope (*2933*). Also occasional on the mesa above the southwest point of the main island (*2854*). Determined by Mathias and Constance. Previously known only from San Nicolas Island, California.

CONVOLVULUS MACROSTEGIUS Greene. Occasional on the inner slope (*2921*).

CRYPTANTHE FOLIOSA Greene. Infrequent on the inner slope (*2941*).

LYCIUM CALIFORNICUM Nutt. Common on crater floor (*2940*).

CASTILLEJA GUADALUPENSIS Brandegee. Occasional on the inner slope (*2922*).

GALVEZIA SPECIOSA Nutt. Occasional on the north and inner slopes (*2937*).

BAERIOPSIS GUADALUPENSIS J. T. Howell. Occasional on the north and inner slopes (*2934*). Previously known only from the type collection, from the south end of Guadalupe Island.

COREOPSIS GIGANTEA (Kell.) Hall. Common on the crater floor and the inner slope (*2923*). Two flower heads shot down from the cliffs of Inner Islet (*2868*).

HEMIZONIA GREENEANA Rose. Common on the inner slope (*2925*). Not in flower here, and flowering very scantily at the south end of the main island.

PERITYLE INCANA Gray. Common on the inner slope (*2931*). Not in flower here though flowering on cliffs above Northeast Anchorage.

STEPHANOMERIA GUADALUPENSIS Brandegee. Occasional on the inner slope, without flowers; juice milky orange (*2926*). Determined by J. T. Howell.

NOTEWORTHY PLANTS OF THE MAIN ISLAND

BROMUS MOLLIS L. Occasional in the canyon mouth at Northeast Anchorage (*2881*). Not previously reported from Guadalupe Island.

Triteleia lugens Greene. North-facing basaltic cliff at about 3500 feet elevation at the north end of the island (*2914*). Collected by Brandegee in Sparmanns Canyon.

Dudleya sp. Same locality; only a single clump found (*2915*). This resembles members of the *D. caespitosa* complex, but without flowers it cannot be surely assigned even to subgenus. For a photograph, see Moran and Lindsay 1950.

Jepsonia Parryi (Torr.) Small. Same locality (*2917*). When collected in April, the plants bore leaves but no flowers; at the Rancho Santa Ana Botanic Garden in August 1950, they flowered while leafless. Clearly this is the same as the sterile specimens in the Herbarium of the University of California collected on Guadalupe Island by Brandegee in 1897 and by Drent in 1898. The species has not previously been reported from Guadalupe Island, unless it is the *"Heuchera?"* reported from sterile material collected by Palmer and by Franceschi.

In the three collections from Guadalupe Island, the rhizome is 5 to 12 mm. thick and the leaves are mostly 4 to 8 cm. wide. In specimens from the islands and mainland of southern California, the rhizome (except for a thicker basal corm) is about 1 to 6 mm. thick, and the leaves are 2 to 6 cm. wide. The flowers of the Guadalupe plant are similar to those of several collections from southern California. The hypanthium including the sepals is 3 to 4 mm. long, and the sepals are about ½ to 1 mm. long.

Ruta graveolens L. Three sterile plants in the canyon mouth at Northeast Anchorage (*2843*). Not previously reported from Guadalupe Island.

Oenothera micrantha Hornem. Occasional in the canyon mouth at Northeast Anchorage (*2891*). Determination verified by P. A. Munz. Not previously reported from Guadalupe Island, whence the closely related but little-known *O. guadalupensis* S. Wats. was described. No *Oenothera* has been found before at this well-collected spot; and, moreover, it is here that many aliens have first been noted on the island. It therefore seems likely that *O. micrantha* is a new arrival.

Nicotiana glauca Graham. Well established in and about the canyon mouth at Northeast Anchorage (*2838*). Not previously reported from Guadalupe Island and doubtless a new arrival.

Bailey Hortorium, Cornell University,
Ithaca, New York

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SUPPLEMENT TO THE FLORA OF WHATCOM COUNTY, WASHINGTON

W. C. Muenscher

Since the publication of the Flora of Whatcom County, Washington in 1941[1] several visits to the county have afforded opportunity to observe and collect a few additional species. Some of these were previously overlooked, others may represent recent adventives or introductions. These, with annotations and dates for first observation, are here recorded.

Potamogeton obtusifolius M. & K. This very distinct species of pondweed was abundant during July, 1950, in extensive areas in four to six feet of water in Wiser, Barrett, and Terrell lakes. Apparently it has not been recorded previously from west of the Rocky Mountains south of British Columbia.

Zizania aquatica L. Wild Rice. Local on muddy bottom in three to four feet of water toward the west end of Wiser Lake. Numerous visits during the last forty years have never revealed its presence previous to 1950. Probably it was here introduced to improve feeding areas for water fowl.

Scirpus cyperinus (L.) Kunth. Forming clumps in shallow water in marshy ground about Terrell Lake and Barrett Lake. Not previously reported from west of the Rocky Mountains; possibly introduced in recent years.

Polygonum cuspidatum Sieb. & Zucc. Persisting and spreading in several places where it was introduced.

Lepidium perfoliatum L. Although I have known this weed from eastern Washington since 1916 and it is now widespread in the Great Basin area, it does not seem to have been reported before from Whatcom County. On dry bank near shore of Birch Bay; 1950.

Rorippa sylvestris (L.) Bess. Established as a weed on slopes in Bellingham and near Lake Whatcom where it was apparently brought in with flower plantings; 1947.

Cuscuta epithymum Murr. Clover Dodder. Appeared in cleared upland seeded to red clover near Goshen; 1947. On roadside south of Birch Bay; 1937.

Satureja Acinos L. Scheele. Well established in grassy opening by Silver Lake; 1947. Probably introduced with grass seed.

Veronica filiformis Sm. Creeping Speedwell. Spreading from places where it had been introduced as an ornamental in rock gardens, Bellingham; 1947. In the northeastern states it has overrun lawns and become a noxious pest.

Aster pilosus Willd. Appearing as if adventive near the beach, Birch Bay. First observed over several acres in 1943; by 1950 it had spread to large areas of dry gravelly grasslands.

[1] Muenscher, W. C. The Flora of Whatcom County, State of Washington—Vascular Plants. 1941. pp. 1–139. Fig. 1–10. Ithaca, N. Y.

Cotula coronopifolia L. Common on muddy borders of brackish marshes and margins of tidal streams. I have observed and collected this species from several stations, but failed to record it earlier. Semiahmoo Bay, 1919; Lummi Point, 1933, 1937, 1943; Point Roberts, 1937; Eliza Island, 1939; Chuckanut Bay, 1939; Neptune Beach and Terrell Lake, 1950.

Lactuca muralis Fresen. Common in the shade under evergreen trees in city park, Lynden; 1950.

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AN ANTHRACNOSE DISEASE OF UMBELLULARIA CALIFORNICA[1]

John M. Harvey[2]

A fungus considered here as belonging to the genus *Kabatiella* was found to be associated consistently with diseased leaves of the California laurel tree, *Umbellularia californica* Nuttall, collected in the coast ranges of central California.

Brown, necrotic patches, originating at the tip, lateral margins, or petiolar region of the leaf, are produced by this fungus and may eventually extend over the whole leaf (pl. 3, fig. A). The affected areas often have a rather roughened appearance due to numerous acervuli which break through the epidermis.

Kabatiella seems to be present in such diseased leaves throughout the year, at least in the rather humid and temperate coastal areas where collections were made. The older leaves (2–3 years old) were most commonly infected with the fungus, although in some cases where branches died back for other reasons, *Kabatiella* was isolated from younger leaves.

Taxonomy of the Causal Agent

Bubak (1907) established the genus *Kabatiella* on June 8, 1907, naming a new imperfect fungus, *K. microsticta* Bubak, found on *Convallaria majalis* L. A second species, *Kabatiella ribis* Vasil. on black currant, was described by Vassilievsky (1923). Atkinson and Edgerton (1907) erected the genus *Protocoronospora* in September, 1907, and described *P. nigricans* Atk. and Edgert., a pathogenic species found on cultivated vetch, as the type. These authors noted the resemblance of the spores in mass to those of the anthracnose fungi in the order Melanconiales, but regarded the fungus as being a basidiomycete because of the peculiar spore-bearing structures. They considered these to be basidia and observed that from four to eight sessile spores were borne in a whorl at the end of these basidia.

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[1] A revision of a section of a thesis submitted to the Graduate Division of the University of California at Berkeley in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

[2] The author wishes to acknowledge his indebtedness to Dr. H. N. Hansen and other members of the Division of Plant Pathology for counsel and advice in this work.

Further study was made of this fungus by Wolf (1920) who found cytological evidence confirming that the structures regarded as basidia by Atkinson and Edgerton were conidiophores and that the fungus properly belonged in the order Melanconiales.

In reviewing this group of fungi, Karakulin (1923) was convinced that his *Exobasidiopsis viciae* Karak. described in 1922 is identical with *Protocoronospora nigricans* and that *Kabatiella microsticta, K. ribis, Pachybasidiella polyspora* Bub. and Syd. and *Gloeosporium caulivorum* Kirch. are all congeneric with the first two above mentioned pathogens. *Kabatiella,* having priority is the generic name to be used. Therefore, Karakulin included the following species in *Kabatiella* and made the necessary transfers: *K. microsticta* Bubak, *K. polyspora* (Bub. and Syd.) Karak., *K. ribis* Vassil., *K. caulivora* (Kirch.) Karak. and *K. nigricans* (Atk. and Edgert.) Karak. Wolf and Wolf (1947, p. 394) apparently accept Karakulin's revision for they state that "the so-called *Protocoronospora nigricans* in vetch appears properly to belong in *Kabatiella.*" Sampson (1928) in her studies on the red clover anthracnose employs *Kabatiella caulivora* for the fungus previously designated as *Gloeosporium caulivorum.*

The genus *Protocoronospora* appears, therefore, to be invalid and species formerly placed in that genus should be placed in *Kabatiella.* The original descriptions of both genera appear to apply to similar fungi, the chief distinction being whether the conidia are borne sessile or on sterigmata. The fundamental character common to all the fungi referred to *Kabatiella* by Karakulin is the possession of a conidiophore of the pseudobasidial type. The club-shaped conidiophores arise from a small cushion or large stroma-like hymenial layer and emerge either through the stomata or by rupturing the epidermis. Several hyaline, unicellular conidia are borne terminally or rarely laterally on very minute stalks which are scarcely visible until after the conidia fall. Since even in species long recognized as belonging in *Kabatiella,* the sterigmata are sometimes not visible until after the conidia have fallen from the conidiophore, it is conceivable that they were present in *P. nigricans,* but not observed or not interpreted as such. This character does not in any event seem to justify the separation of two genera so similar in other characteristics.

A fungus found to cause a disease of mistletoe, *Phoradendron flavescens* (Pursh) Nuttall var. *macrophylla* Engelm. was considered by Darling (1940) to be sufficiently distinct from *Protocoronospora nigricans* to warrant its description as *P. Phoradendri,* a second species in the genus. One of the chief differences, aside from the respective host plants, was the fact that the conidia of *P. nigricans* germinate by budding or by germ tubes, while those of

P. Phoradendri were observed to germinate only by a germ tube and never by budding. Darling states in her description of the species that small sterigmata are present, which fact, if used as a generic character would in any event place this fungus in *Kabatiella* rather than in the genus *Protocoronospora.* The following transfer is therefore proposed:

Kabatiella Phoradendri (Darling) comb. nov. *Protocoronospora Phoradendri* Darling, Madroño 5: 242. 1940.

The genus *Aureobasidium* Viala and Boyer described in 1891 has been listed as being synonymous (Ainsworth and Bisby, 1945, Clements and Shear, 1931) with *Kabatiella,* but this has not been confirmed by critical studies. Karakulin, in his discussion of fungi belonging in the genus *Kabatiella* fails to mention *Aureobasidium.* Various authors (Ciferri, 1922) have placed this genus near *Exobasidium,* while others have placed it in the Deuteromycetes. As originally described, the genus (Viala and Boyer, 1891) was considered to belong in the Basidiomycetes. Viennot-Bourgin (1949, p. 609) regards certain species of the form genera *Aureobasidium, Dematium, Exobasidium* and *Pullularia* as being synonymous, these species possessing *Anthostomella* as the ascigerous stage. This latter group of fungi possesses characters quite different from the fungus considered herein whose characters agree more closely with those of the genus *Kabatiella.*

MORPHOLOGY

Kabatiella Phoradendri was isolated from leaves of mistletoe collected on the northwest shore of Clear Lake, California (January 25, 1950) in order to compare it with the *Kabatiella* isolate from California laurel.

The acervuli of the *Umbellularia* isolate usually break through the lower (occasionally the upper) epidermis of the leaves. Their size varies from 155 to 263 microns in diameter. No setae were observed in the acervuli of this isolate although they are reported to occur in *K. Phoradendri* and *K. nigricans* and are reported as being absent in *K. caulivora.*

The conidiophores are clavate to cylindrical, 21–65 microns long and 7 to 11 microns broad. One to eleven conidia are borne terminally (pl. 4, fig. C) on small obscure sterigmata that are visible only after the conidia are shed.

The conidia of the isolate of *Kabatiella* found on *Umbellularia californica* are 20.1–28.9 microns long and 2.8–3.5 microns broad, average 24.2 × 3.1 microns. They are allantoid in shape and muticate (pl. 4, fig. B). In contrast, the conidia of *Kabatiella Phoradendri* are 15–26 microns long and 4.5–6.5 microns broad and much more curved, being described by Darling (1940) as falcate (pl. 4, fig. A).

The mycelial hyphae of the *Umbellularia* isolate are 3.2–5.6 microns in diameter.

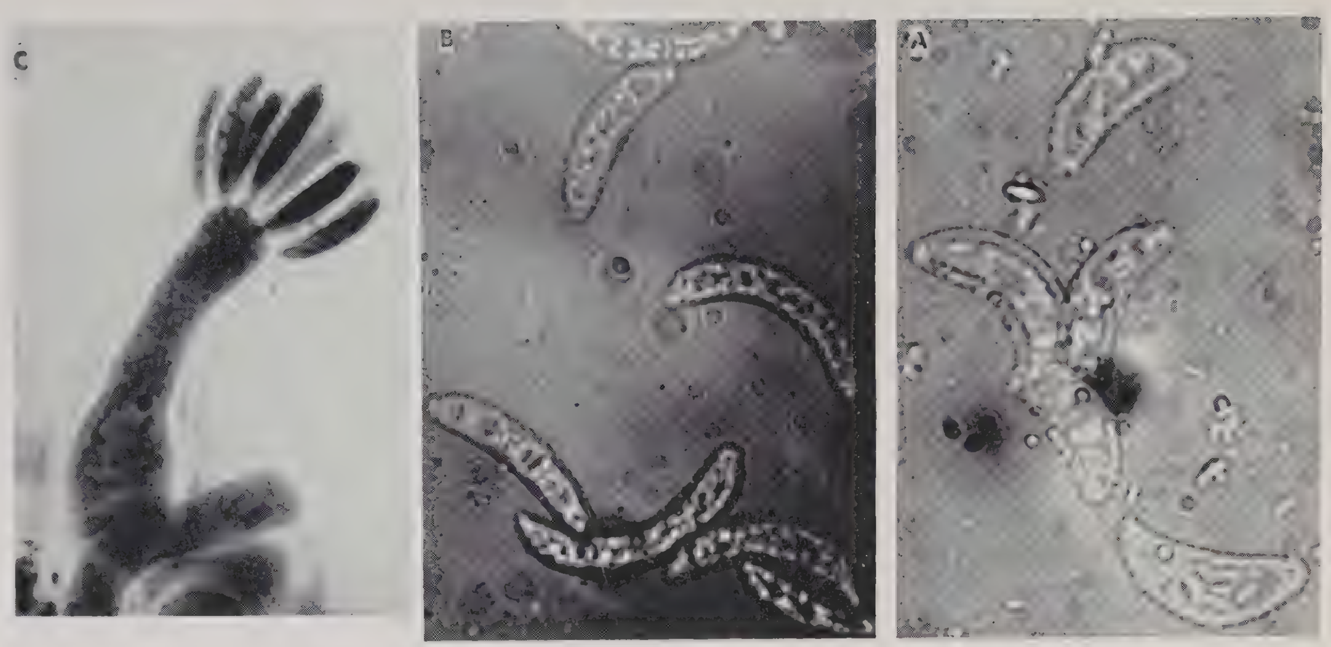

Plate 4. Conidia of Kabatiella. Fig. A. *Kabatiella Phoradendri* (× ca. 1160). Fig. B. *Kabatiella Phoradendri* f. *umbellulariae* (× ca. 1160). Fig. C. Conidiophore and conidia of *K. Phoradendri* f. *umbellulariae* (× ca. 650).

In old cultures conidia of the *Umbellularia* isolate were observed to give rise to new conidia either at their ends or sides. When this phenomenon occurred the protoplasm from the old conidium moved out into the new one. It is doubtful if one could regard this as a true process of budding in the sense of a yeast budding. In the latter case both resulting cells contain functioning protoplasts. The type of budding which Wolf (1920) describes as occurring in *Kabatiella nigricans* and which Martin (1928, 1929) describes as occurring in *K. microsticta* and *K. polyspora* has not been observed in the isolate from *Umbellularia californica.* When conidia of this fungus were plated out on water agar, they germinated by germ tube only. In this character this isolate seems to resemble *Kabatiella Phoradendri,* but differs from *K. nigricans, K. ribis, K. microsticta, K. polyspora* and *K. caulivora.*

Cultures on potato dextrose agar slants show very slow and sparse growth even when kept at optimum temperatures for growth. The conidia are cream colored in mass and the mycelium, at first hyaline, darkens with age, resulting in colonies which are greyish-white in color on the perimeter, but dark brown to black in the center.

On oatmeal agar slants, growth is greater than on potato dextrose agar under similar environmental conditions. More mycelial growth is made, but the colonies still remain compact and turn dark with age.

On both the above media, greater conidial production was observed if inoculation was made by pouring a spore suspension over the entire surface of the medium rather than by introducing single spores or mass transfers of mycelium.

Growth was good and acervulus formation excellent on a natural medium of sterile pea straw in agar plates prepared according to the method described by Hansen and Snyder (1947). Plates inoculated February 1, 1950, and kept in a rack outside the laboratory window showed well-formed acervuli in six days. On this medium the conidia are pink-colored in mass. Dried leaves of *Umbellularia californica* ground and prepared by the same method proved to be equally as good as the pea straw for the growth of this fungus.

TEMPERATURE RELATIONS

Tests were made to determine the effect of temperature on the growth rate of the isolate from *Umbellularia* and of *Kabatiella Phoradendri.* Single spore cultures on potato dextrose agar were prepared and placed in unlighted temperature chambers at temperatures ranging from 1 to 31° C. The diameters of the colonies were measured at the end of twenty-eight days to determine relative growth rates. The critical temperatures for growth for the isolate from *Umbellularia californica* were 4, 16 and 25° C. (pl. 5, fig. C). Those for the mistletoe isolate were 4, 22,

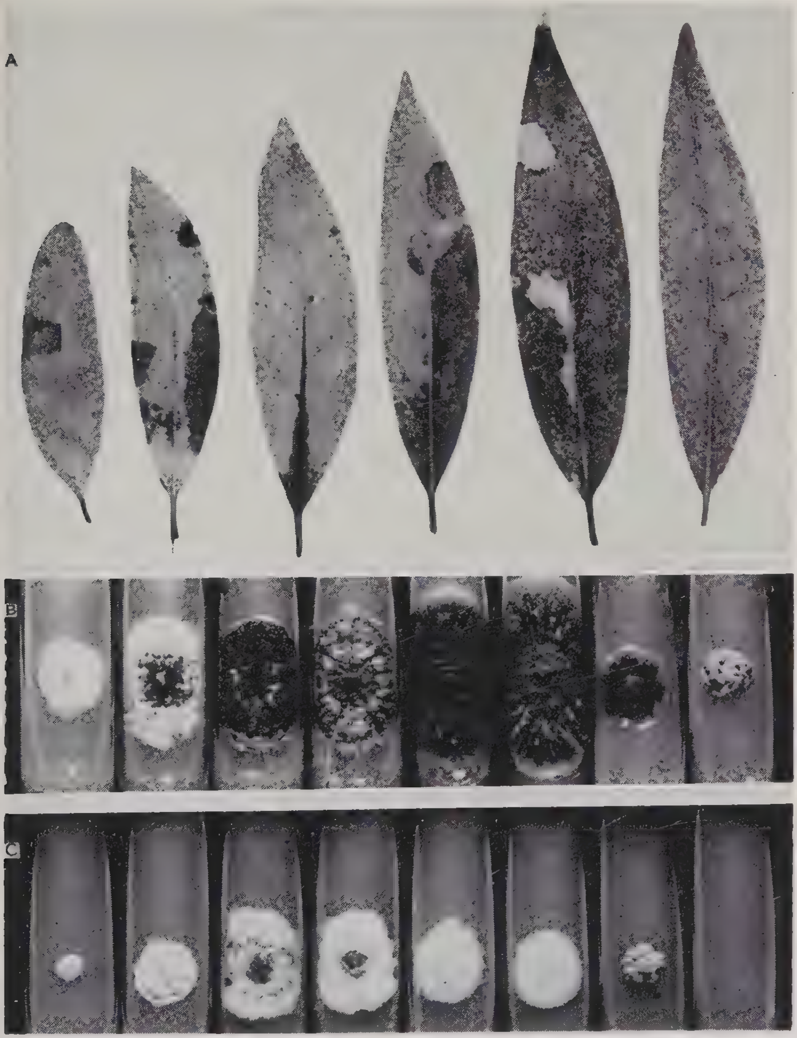

Plate 5. Kabatiella. Fig. A. Leaves of *Umbellularia californica* infected with *Kabatiella Phoradendri* f. *umbellulariae*. Fig. B. Cultures of *K. Phoradendri* on potato dextrose agar kept at 7° C. (left) to 28° C. (right) at 3 degree intervals. Fig. C. Cultures of *K. Phoradendri* f. *umbellulariae* (same culture conditions as in B).

and 28° C. (pl. 5, fig. B). Thus the mistletoe isolate can tolerate a somewhat greater range in temperature and grows best at a temperature somewhat higher than the temperature for optimum growth of the isolate from *U. californica.* Considering the regions in which the respective fungi are most commonly found, this difference in behavior toward temperature might be expected. The temperatures are rather moderate in the coastal region from which most of the *Kabatiella* isolations from *Umbellularia californica* were made. On the contrary, *Kabatiella Phoradendri* was isolated from mistletoe plants growing in a region where the fluctuations in temperature are more extreme and the average temperature is somewhat higher.

It was found that the optimum temperature for sporulation was 10° C. for the isolate from *Umbellularia* whereas sporulation was equally great at 10 and 13° C. for *Kabatiella Phoradendri.* In both fungi, sporulation was greatly reduced at higher temperatures.

INOCULATION EXPERIMENTS

Some difficulty was experienced in infecting living leaves of *Umbellularia californica* with *Kabatiella* isolated from this host. Seedlings kept for two days in a moist chamber out of doors were inoculated by spraying with a spore suspension. Some of the leaves had been wounded previously by scratching or pricking with a dissecting needle. These were kept in a moist chamber for two days after inoculation but they failed subsequently to show evidence of infection.

When leaves, dried and sterilized with propylene oxide (Hansen and Snyder, 1947), were placed in a sterile moist chamber and inoculated by spraying with a spore suspension of the fungus, development took place rapidly. At first the mycelium and acervuli appeared to be growing only on the surface of the dead leaves, presumably being nourished by materials which had diffused out from the leaf into the water on the leaf surface. This mycelium had not invaded the tissue and could easily be scraped off with a dissecting needle. Two weeks after inoculation, however, the fungus had invaded the leaf tissue, and numerous acervuli could be observed erupting through the epidermis of the leaf. This would seem to indicate that this isolate of *Kabatiella* is a rather weak parasite, but readily assumes a saprophytic existence.

Detached twigs of *Umbellularia californica,* each bearing several leaves, were placed in moist chambers, the basal end of the twig being immersed in a beaker of water. Some of the leaves were wounded by scratching them with a dissecting needle. Two twigs were inoculated by spraying with a spore suspension of the *Kabatiella* isolate from *Umbellularia californica,* and the third with *Kabatiella Phoradendri.* Two of these moist chambers with contents were placed in unlighted temperature chambers at the optimum temperatures for the respective pathogens, i.e., 13° C. for the *Kabatiella* from *Umbellularia californica* and 22° C. for *Kabatiella Phoradendri.* The remaining chamber, in which the leaves were inoculated with the *Kabatiella* from *Umbellularia californica,* was kept out of doors (March 14, 1950).

At the end of ten days all the inoculated leaves kept in the temperature chambers had become infected. Acervuli were formed abundantly along the wounds in the leaves, and also were formed on unwounded leaves. Acervuli were especially prominent along the advancing margins of infection. The inoculated leaves kept out of doors showed no infection.

LIFE CYCLE

Though the isolate of *Kabatiella* from *Umbellularia californica* was studied on a variety of culture media and on diseased leaves, no perfect stage was ever observed. This was also the experience of Wolf (1920) with *Kabatiella nigricans.* No reference to the discovery of a perfect stage for members of this genus was found by the author. The organism seems to persist in the leaves, however, in a mycelial state producing acervuli readily under proper conditions. Since the leaves remain on *Umbellularia californica* for several seasons, the fungus can maintain itself by sporulating on diseased parts of older leaves, disseminating conidia from these foci of infection to younger leaves from year to year.

Such a hold-over in the vegetative state was demonstrated by Wolf (1920) with *Kabatiella nigricans.* The mycelium of this pathogen can remain alive in old infected parts of vetch and also is seed borne, the mycelium penetrating well into the seed. The longevity of the conidia of *K. caulivora* has been shown by Sampson (1928), the conidia remaining viable on red clover seed for eighteen months after harvest.

DISCUSSION

The characteristics of the fungus isolated from *Umbellularia californica* are most similar to those of fungi placed in the genus *Kabatiella.* As reported in the literature, the species constituting this genus appear to differ chiefly, aside from host relationships, in the manner in which the conidia germinate and in the manner in which they are borne, i.e., sessile or on sterigmata.

The conidia of *Kabatiella nigricans* and *K. polyspora* (Bubak and Sydow, 1915) are reported as being sessile. Those of *K. microsticta, K. ribis, K. caulivora* and *K. Phoradendri* are reported as being borne on sterigmata, although these are minute and often are apparent only after the conidia are shed. This fact might indicate that sterigmata were present, but not observed or not construed as such in the first two species mentioned. In any event, this does not appear to be a reliable character upon which to base a differentiation of species.

The conidia of *K. nigricans, K. ribis, K. microsticta, K. polyspora* and *K. caulivora* have been reported to germinate by budding. In *K. Phoradendri* no budding is reported to occur. In this character the isolate of *Kabatiella* from *Umbellularia californica* resembles *Kabatiella Phoradendri* and differs from the other species in the genus.

Though the new isolate resembles *K. Phoradendri* in the above character, the two fungi differ from one another morphologically in the shape and size of the conidia, physiologically in their respective temperature ranges, and in the symptoms they produce on their respective hosts.

The proper placement of a newly discovered fungus in such a genus as *Kabatiella* would involve a detailed study of all the species in the genus and perhaps in closely related genera, a task somewhat beyond the scope of the present study. The isolate from *Umbellularia californica* seems, however, to be related to *Kabatiella Phoradendri* more closely than to the other species in the genus, in so far as can be determined from the literature. Both fungi are found in close proximity, the respective hosts being native to the regions in which collection of diseased specimens was made; in old cultures of the isolate from *Umbellularia californica* the conidia assume a shape which approaches that of the conidia of *Kabatiella Phoradendri;* and in both fungi the conidia are borne on minute sterigmata which are visible only after the spores are shed. Furthermore, *K. Phoradendri* was induced to grow on *Umbellularia* in culture.

Considering the wide range of variability which can occur in a single species, as demonstrated in species belonging to the genus *Fusarium* by Snyder and Hansen (1940), it appears that the differences exhibited by these two isolates might well represent such variation within the species *Kabatiella Phoradendri.* It seems, therefore, on the basis of host relationships, best to regard the isolate from *Umbellularia californica* as a form of *Kabatiella Phoradendri,* rather than as a new species.

KABATIELLA PHORADENDRI Darling f. **umbellulariae** forma nova. A specie conidiis angustioris minus curvatis differt. Habitat in foliis Umbellulariae (Lauracearum). America Borealis.

Type. On *Umbellularia californica* Nuttall, north side of Russian River near Monte Rio, Sonoma County, California, November 15, 1949, *John M. Harvey* (Herb. Univ. Calif. no. 924306).

This form has been collected on *Umbellularia californica* in Alameda, Contra Costa, Santa Cruz, Marin, Mendocino, Sonoma, Napa and Lake counties, California.

SUMMARY

A fungus belonging in the genus *Kabatiella* was found to be

consistently associated with diseased leaves of *Umbellularia californica.* Symptoms are brown, necrotic areas which appear near the tip, lateral margins, or base of the leaf.

The pathogen was isolated, studied in culture, and compared with related organisms. Inoculation experiments were carried out to determine the pathogenicity of the fungus.

The position of the closely related fungus, *Protocoronospora Phoradendri* is discussed and its transfer to *Kabatiella* is proposed. The isolate from *Umbellularia californica* is proposed as a form of *Kabatiella Phoradendri.*

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BOTANY OF THE INTERMOUNTAIN REGION—II. LESQUERELLA

Bassett Maguire and Arthur H. Holmgren

Intermountain field study in the genus *Lesquerella* over the past few years had made necessary the earlier review of species of the *L. utahensis* group (Maguire, 1942). Now question is raised over problems that have been uncovered in three other centers within the genus, viz. (1) *L. Hitchcockii,* (2) *L. occidentalis,* and (3) *L. Kingii.* Consideration of them will follow in order.

Lesquerella Hitchcockii Munz

Two populations in *Lesquerella,* both of such similar morphological character as to demonstrate a close consanguinity, but each of restricted and independent physiographic range, have been established as species. One of these is from the Charleston Mountains and the nearby Sheep Range in the Mohave Desert, Clark County, Nevada, and has been called *L. Hitchcockii* (Munz, 1929, p. 163), and the other from the Paunsauqunt Plateau in Garfield and Piute Counties, Utah, as *L. rubicundula* (Rollins, 1941, p. 178).

Subsequently, the writers made two collections from the Great Basin, in still another physiographic region, in the Quinn Canyon Range, Nye County, Nevada, and thus revealed a third population that is closely related to the two above. These and further specimens of *L. rubicundula* collected from its type locality, Red Canyon, have made necessary a more detailed consideration of the most probable relationship that obtains among the three populations.

Rollins (loc. cit.) has ascribed differences between *L. Hitchcockii* and *L. rubicundula* as follows: "Our plant differs from *L. Hitchcockii* in having much shorter styles; longer, linear instead of obovate or spatulate leaves; and sessile instead of subsessile fewer siliques. The siliques of *L. rubicundula* are ruddy, but not a deep red as in *L. Hitchcockii.*"

From the additional material now available, appraisal of Rollins' conclusions is largely confirmatory; there are significant style and leaf differences, but a short stipe seems to be consistently developed in both populations, and silique color seems to be of negligible importance.

The third population, that from the Quinn Canyon Range, is the most robust of the three, having larger leaves, flowers, and fruits, with the last in addition, oblong-elliptic rather than subglobose. Closer affinity apparently lies with *L. rubicundula;* indeed, some specimens vegetatively are hardly separable from it. But on the other hand, broader-leaved plants are inseparable from the more lax specimens collected at the type station of *L. Hitchcockii.* In Table 1 are summarized the seemingly pertinent data

TABLE 1. SUBSPECIES OF LESQUERELLA HITCHCOCKII

	Subsp. *Hitchcockii*	Subsp. *rubicundula*	Subsp. *confluens*
Habit	Closely multicipital, branches short.	Closely multicipital, branches short, or branches few, becoming slender, elongate and rhizomatous.	Multicipital, but branches numerous, becoming rhizomatous.
Principal leaves	5–14 mm. long (av. 8.6), 1.7–4.2 mm. wide (av. 2.9), obovate, spatulate to oblanceolate, petioles abruptly formed and short, or less often equalling or exceeding the blade.	5–12 mm. long (av. 8.5), 1–2.2 mm. broad (av. 1.4), linear to linear-oblanceolate, narrowed into a scarcely distinct petiole.	10–24 mm. long (av. 14.1), 1–3 mm. broad (av. 1.92), oblanceolate to nearly elliptic, the blade elliptic-oblanceolate, shorter than the petiole.
Leaf width-length ratio	1:2.8 av. ratio	1:6.0 av. ratio	1:7.4 av. ratio
Pedicels	3.5–5.0 mm. long (av. 3.3)	2.0–5.0 mm. long (av. 3.3)	3.0–7.0 mm. long (av. 3.9)
Sepals	3.7–5.2 mm. long (av. 4.5)	3.0–4.5 mm. long (av. 4.0)	4.0–6.5 mm. long (av. 5.7)
Petals	5.0–7.2 mm. long (av. 6.4)	4.0–8.5 mm. long (av. 6.8)	5.0–9.0 mm. long (av. 8.0)
Silique	Substipitate, subglobose, 3.0–5.5 mm. long (av. 4.0)	Substipitate, or sessile, subglobose, 2.5–4.5 mm. long (av. 3.8)	Substipitate, oblong-elliptic, 3.5–6.0 mm. long (av. 4.8)
Style	2.7–5.5 mm. long (av. 3.5)	1.7–3.7 mm. long (av. 3.2)	3.5–6.0 mm. long (av. 4.8)
Range	"Broken rocks" at timberline, Charleston Mountains; Sheep Range, Clark County, Nevada.	Eroded clay-gravel slopes, Red Canyon; Panguitch, Garfield County, Utah.	Talus and loose gravelly slopes, Quinn Canyon Range, Nye County, Nevada.

obtained from careful measurement of the material at hand.

It seems clear, then, from the above considerations, that the three more or less distinct but intergradient regional populations constitute but a single polymorphic species.

Key to the Subspecies of L. Hitchcockii

Leaves usually 2–4 mm. wide, 6–12 mm. long, spatulate to broadly oblanceolate, the blades abruptly or sometimes gradually narrowed into a short petiole; average leaf width-length ratio 1:2.8 . . 1. *L. Hitchcockii* subsp. *Hitchcockii*

Leaves usually 1–3 mm. wide, 10–20 mm. long, oblanceolate to nearly linear, narrowed into slender petiole equalling or longer than the blade; average leaf-width ratio 1:7.4 . . . . 2. *L. Hitchcockii* subsp. *confluens*

Leaves mostly 1–2 mm. wide, 5–10 mm. long, linear to narrowly oblanceolate, hardly at all narrowed into a petiole; average leaf width-length ratio 1:6.0 . . . . 3. *L. Hitchcockii* subsp. *rubicundula*

1. LESQUERELLA HITCHCOCKII subsp. **Hitchcockii.** *L. Hitchcockii* Munz, Bull. Torrey Club 56: 163, 1929, as to type.

Type locality. High exposed ridges at 10500 ft., Charleston Mountains, Clark County, Nevada, September 1, 1927, *Jaeger & Hitchcock sine no.* (Pomona No. 45092).

Distribution. Known only from the Charleston Mountains and Sheep Range, Clark County, Nevada.

Representative specimens. Charleston Mountains: benches at 11000 ft., June 26, 1926, *Jaeger sine no.;* Kyle Canyon, July 22, 1930, *Goodman & Hitchcock 1685.* Sheep Range: dry creek bed and banks 7600 ft., Hidden Forest, June 10, 1940, *Alexander & Kellogg 1697.*

2. LESQUERELLA HITCHCOCKII subsp. **confluens** subsp. nov. Herba perennis multicipitalis, ramis numerosis ex rhizomatis, foliis anguste oblanceolatis vel sublinearibus 1–3 mm. latis, 10–24 mm. longis (med. 2.9 × 14.1 mm.), latitudine-longitudine rationibus mediis 1 : 7.4, siliculis oblongo-ellipticis substipitatis 3.5–6.0 mm. longis, stylis 3.5–6.0 mm. longis.

Type. Loose gravelly soil along little draws in open juniper and pinyon pine, 7000 ft., ridge north of Cherry Creek Pass, frequent, June 20, 1945, Quinn Canyon Range, Nye County, Nevada, *Maguire & Holmgren 25534* (New York Botanical Garden, Utah State Agricultural College).

Distribution. Known from only the Quinn Canyon Range by the type and a second collection: upper Cherry Creek, June 23, 1945, *Maguire & Holmgren 25590.*

3. Lesquerella Hitchcockii Munz, subsp. **rubicundula** (Rollins) comb. nov. *L. rubicundula* Rollins, Contr. Dudley Herb. 3: 178. 1941.

Type. Red Canyon, 2300 m., Powell National Forest, Garfield County, Utah, July 6, 1912, *W. W. Eggleston 8198* (Herb. Nat. Arboretum).

Distribution. Known only from red clay and gravelly banks in Garfield, and Piute counties, Utah.

Representative specimens. Gravel, 7000 ft., Maryvale, Piute County, June 6, 1894, *Jones 5404;* Panguitch, Garfield County, July 18, 1920, *Jones sine no.;* dry gravelly slopes in sparse yellow pine and pinyon pine, frequent, 7000 ft., 3½ mi. east mouth Red Canyon, Garfield County, June 25, 1940, *Maguire 19075,* topotype; red limestone gravel slides, Red Canyon, Garfield County, June 7, 1947, *Ripley & Barneby 8544.*

Lesquerella occidentalis S. Wats.

Two names, *Lesquerella diversifolia* Greene and *L. Cusickii* Jones, have generally, since their proposal, been accepted as representing distinct specific populations, however close they might be to the first recognized *L. occidentalis.* A brief historical review will facilitate a consideration of their proper status and relationship.

Watson (1885, pp. 353–354) described *Vesicaria occidentalis* from three collections which we now have before us: near Yreka, California, *E. L. Greene,* in 1876; Multnomah County, Oregon, *T. J. Howell;* and, White Bluffs of the Columbia, Washington Territory, *T. S. Brandegee.* The first of these, designated as the type by Payson (1922, p. 224), is a single specimen with essentially erect stems about 17 cm. high, coarsely sinuate leaves, and compressed pods. The other two, the Howell specimen deposited at Gray Herbarium, and the Brandegee specimen at the National Herbarium, are *Lesquerella Douglasii* (proposed by Watson three years later in 1888) and consequently are of no concern here. The name *L. occidentalis* therefore must rest on the type, the Greene specimen.

The type, unfortunately a much damaged specimen without caudex, consists of a crown of five apparently ascending fruiting stems from 11 to 17 cm. high with rather numerous oblanceolate coarsely sinuate leaves from 2 to 7 cm. long. It represents one of the less frequently collected biotypes, viz., plants of more or less erect habit. Two other collections from Lassen Peak passed Watson's review at the time. The first, *Lemmon 972* (Gray Herbarium) consists of two specimens, each a distinct biotype and both in early flowering stage, one with an elongate caudex and ascending stems, similar to the type of *L. occidentalis* but with entire leaves, the other with thicker short caudex, apparently decumbent branches and smaller entire leaves. The second collection, made by Mrs. Austin (Gray Herbarium), consists of small plants of uncertain habit, but are with mature fruit compressed in the manner of the type of *L. occidentalis*. These two collections are inscribed in Watson's hand "Vesicaria Kingii Watson—n.sp." and form part of the material upon which the name *Lesquerella Kingii* was based. They both, however, are part of the *L. occidentalis* complex and are greatly different from the Great Basin *L. Kingii* which has subglobose, frequently retuse pods.

More recent collections from the Siskiyou Mountains of California further demonstrate the variability of *L. occidentalis* in the type region: a collection from Marble Mountain at 8000 ft. elevation (*Chandler 1653*) consists of a series of plants with ascending branches like that of the type but for one specimen on the Gray Herbarium sheet in which the branches are decumbent. In all of these the leaves are large, entire, or once-toothed, except in the decumbent specimen. In this the leaves are smaller. A collection from Black Mountain near Marble Mountain at 6800 ft. (*Hitchcock & Martin 5305*) is a series of depressed heavy caudexed plants, of the *L. diversifolia* phase, as is a collection from Anthony Peak, Mendocino-Tehama County (*Eastwood & Howell 9859*).

Mention should be made of a Cusick collection (no. *2054*), the printed label for which bears the indefinite locality, "Stein's [Steens] and southern Blue Mountains." All the plants of this well distributed series are vigorous, essentially erect plants with stems reaching 30 cm. in height, shallowly toothed or repand leaves some 8 cm. in length; likewise the exceedingly coarse specimen (*Peck 16012*), from Wheeler County, Oregon, is of the same habit with stems 25 cm. high, and large sinuate leaves 8 cm. long.

Specimens of diverse habit, prostrate or ascending, were until 1901 interpreted as *L. occidentalis*. At that time Greene (1901, p. 309), without reference to the older name proposed *L. diversifolia* based on *Cusick's* collection (*2304*) from the Wallowa Mountains, Wallowa County, Oregon, as "Small and rather slender perennial, caudex simple or with 2 or 3 short branches: tufted leaves small, all on rather slender petioles longer than the blade, this from round-ovate to ovate-hastate, rhombic-ovate and ovate-lanceolate, seldom one-half inch long, both faces canescently lepidote: racemose peduncles 2 to 4 inches long, decumbent or assurgent, floriferous at summit, below it conspicuously leafy-bracted, the bracts oblanceolate: calyx and ovaries lepidote; pods not seen." Four isotype sheets are before us (none with mature fruits). Those from the Washington State College (no. 11231) and the National Herbarium (no. 362551), and the New York Botanical Garden consist of plants that conform to the type description. The sheet from Gray Herbarium has three specimens, two "small and rather slender," but the third is a vigorous plant with a coarse woody root and a heavy caudex some 6 cm. long that indicate a duration of several years at least. The leaves reach a length of 7 cm. and the procumbent or flexuous flowering shoots a length of 15 cm.

Numerous subsequent collections demonstrate considerable diversity and intergradation in habit, in duration, size and form of leaf, and in pod size. Habits range from small, few-stemmed depressed plants of short duration to large, coarse many-stemmed long-lived, large-caudexed specimens, or even to individuals with ascending stems as in the three following collections from the John Day Valley, Grant County, Oregon (*Cusick 3258, Gale 154,* and *Peck 19894*).

One further name comes under consideration, *L. Cusickii* Jones (Jones, 1908, p. 2). The well distributed type series from "white *2367*), are all immature plants in flower and without a well developed perennial caudex. They are without fruit, but by general similarity of form (not always dependable in *Lesquerella*) and locality, there is little doubt that they belong to the *L. occidentalis* complex. Plants of similar habitat from banks of Otis Creek, Malheur County (*Leiberg 2337*), or from Fossil, Gilliam County (*Leiberg 130*), both cited by Payson (1922, p. 225) as *L. Cusickii,* are more or less coarse than the type series but show varying degrees of persistence.

But numerous collections show limited duration and exhibit diversity in habit, habitat, and range, as: *Maguire & Holmgren 25649,* stony slopes, Magruder Mountains, Esmeralda County, Nevada, tiny depressed plants hardly to be recognized as perennial; *Gale 154,* dry ground, Grant County, Oregon, already cited above as transitional between the more or less erect *L. occidentalis* type and the depressed *L. diversifolia* type; or *Thompson 11339,* dry rocky sagebrush, Wheeler County, Oregon, an extensive series of plants with coarse heavy caudexes at one end of the series, but with roots that scarcely seem perennial at the other.

In summary, it is abundantly evident through study in the field, and the examination of eighty-eight herbarium specimens, that the plants going variously under the names *Lesquerella occidentalis, L. diversifolia,* and *L. Cusickii* constitute but a single variable assemblage consisting of several rather distinctive but completely intergrading populations. The prostrate or decumbent form designated by the name *L. diversifolia* is the most extensive and prevails throughout the entire range of the species. The more erect form exemplified by the type of *L. occidentalis* (the oldest and therefore proper name for the assemblage) is considerably less frequent, and is probably the expression of more favorable habitat, but is apparently restricted to the northwestern part of the general range. Juvenile plants of both forms appear to be annuals or short-lived perennials. Plants of short duration and moist calcareous clay or sand habitats seem to be confined to low altitudes in southeastern Oregon, eastern Nevada and northwestern Utah.

They are rosette-making and densely floriferous. Immature plants of this character and environment formed the basis for *L. Cusickii.*

It therefore seems proper to treat the three elements as subspecies under the oldest name, *L. occidentalis.*

Key to the Subspecies of L. occidentalis

Plants strongly perennial (except depauperate plants or those flowering during the first season).

  Flowering stems ascending, 10–20 cm. high; the basal portion of the blade often sinuate, sometimes entire .... 1. *L. occidentalis* subsp. *occidentalis*

  Flowering stems prostrate; the basal portion of the blade entire or once shallowly toothed .... 2. *L. occidentalis* subsp. *diversifolia*

Plants weakly perennial, vigorously flowering during the first season; slender-rooted plants often of moist calcareous clay or sand .... 3. *L. occidentalis* subsp. *Cusickii*

1. Lesquerella occidentalis subsp. **occidentalis.** *Vesicaria occidentalis* S. Wats. Proc. Am. Acad. 20: 353. 1885, as to type. *Lesquerella occidentalis* (S. Wats.) S. Wats. Proc. Am. Acad. 23: 251. 1888.

Type. Near Yreka, California, in 1876, *E. L. Greene sine no.* (Gray Herbarium).

Distribution. Moderate elevations, northern California to north-central Oregon.

Representative specimens. Oregon: Stein's [Steens] and southern Blue Mountains, *Cusick 2054;* Wheeler County, *Peck 16012.*

2. Lesquerella occidentalis subsp. **diversifolia** (Greene) stat. nov. *L. diversifolia* Greene, Pittonia 4: 309. 1901.

Type collection: Wallowa Mountains, Wallowa County, Oregon, *Cusick 2304* (isotypes: Gray Herbarium, U. S. National Herbarium, Washington State College, New York Botanical Garden).

Distribution. Southern Washington and southern Idaho to northern California and Mineral and White Pine counties, Nevada, at altitudes of 7000 to 10,000 feet. This is the most widespread of the three races of *L. occidentalis* and is itself polymorphic.

2a. Lesqurella occidentalis subsp. diversifolia var. **cinerascens** var. nov. Herbae valde cinerascentes perennes multicipitales; ramis prostratis 5–10 cm. longis; foliis radicalibus spathulatis, laminis orbicularibus vel oblanceolatis, 3–8 mm. longis, 3–6 mm. latis; petiolis angustis (10) 15–30 mm. longis, foliis caulinis oblanceolatis petiolatis; racemis elongatis, pedicellis sigmoideis; siliquis valde stellato-pubescentibus ovato-ellipticis, compressis submarginatis, 3–4 mm. longis, 2.5–3.0 (3.5) mm. latis; stylis 1.25–1.75 mm. longis.

Type. Barren calcareous gravel-clay talus at 7200 feet altitude, White Pine Mountains northeast of Hamilton, White Pine County, Nevada, *Ripley & Barneby 9295* (New York Botanical Garden).

Additional specimen. Nevada. Elko County: East Humboldt Mountains [Ruby Range], 10,000 feet altitude, August 1868, *S. Watson 82* (New York Botanical Garden). This specimen bears the same number as does the type of *L. Kingii* from the West Humboldt Range, Pershing County, Nevada, dated June, 1868.

This collection by Ripley and Barneby from east-central Nevada represents a strongly cinereous biotype with small leaves and small pods. The elongated branches have resulted from the plant's being imbedded in loose talus, a not uncommon phenomenon. These specimens seem to represent a good ecologic and possibly also a local variety of restricted distribution.

3. LESQUERELLA OCCIDENTALIS subsp. **Cusickii** (Jones) stat. nov. *L. Cusickii* Jones, Contr. West. Bot. 12: 2. 1908.

Type. White clay hills of Willow Creek, Malheur County, Oregon, *Cusick 2367*.

Distribution. Calcareous clay, central-eastern Oregon, White Pine County, Nevada, and Box Elder County, Utah.

3a. LESQUERELLA OCCIDENTALIS subsp. CUSICKII var. **parvifolia** var. nov. Plantae valde cinereae; foliis spathulatis, laminis orbicularibus diam. 3–5 mm., petiolis 5–8 mm. longis.

Type. Low calcareous hills, 10 miles south of Majors, White Pine County, Nevada, 6000 feet altitude, June 17, 1944, *Ripley & Barneby 6313* (New York Botanical Garden).

Additional specimens. Nevada. White Pine County; calcareous gravel slopes near Shoshone, *Ripley & Barneby 3540* (immature).

Far out of its previously known range, the Nevada population of subsp. *Cusickii* is a symmetrical, conspicuously ash-gray weak perennial with much smaller leaves than is characteristic for the more northern plants.

LESQUERELLA KINGII S. WATS.

Maguire (1942) described a rosette-forming crucifer (from the high central Utah plateau) with obovate or obcordate and obcompressed pods as *Lesquerella hemiphysaria.* Commenting on the significant pod form, he wrote: "The striking emarginate condition obtains nowhere else in the genus." Hardly had that paper been submitted for publication when Holmgren (no. *829*) collected a lax sprawling plant with decumbent branches and immature but obcordate pods in Elko County, Nevada. During the season of 1944, likewise in Elko County, Ripley and Barneby (no. *6220*) collected similar but more physarioid plants with essentially mature obcordate obcompressed pods, and in the following year they collected a similar plant in northeastern Nevada. In 1945

Maguire and Holmgren obtained an extensive and diversified series of seventeen collections extending from east-central Nevada to Mono County, California, from about 5500 feet to over 12,000 feet altitude.

Plants of high altitudes have more or less compact rosettes and globose, obcordate pods 2–4 mm. long and 2.5 mm. broad, which are scarcely to strongly obcompressed. The type collection of *Physaria cordiformis,* a species recently proposed by Rollins (1950), must be placed here, although it is actually intermediate to low elevation forms.

Plants of intermediate altitudes are lax, forming less compact rosettes with fewer, longer, sprawling or ascending branches and larger leaves. The pods are larger, usually more inflated and in some specimens almost spherical; but, characteristically, they are obovate and more or less obcompressed and obcordate. The type collection of *Lesquerella Kingii* belongs here.

Plants of low altitudes, that is of valley benches and floors, are similar in habit but are often coarser. In this phase the pods reach maximum size, as much as 5 mm. long and 7 mm. broad, and are usually obcompressed and obcordate with a broad sinus, but are sometimes merely obovate. In extreme forms the pods are conspicuously obcompressed. Particularly if the specimens collected are a bit young, the wall of the pods tend to contract on drying, accentuating the flatness and the external prominence of the replum ridge.

Plants at one end of the series are altogether lesquerelloid. Plants at the other end of the series, at low altitudes, are strongly physarioid, that is with respect to *Physaria Geyeri.* Thus, the series connects *Lesquerella Kingii* with *Physaria Geyeri,* completely transcending morphological distinction between these representatives of presumably distinct genera. So compelling was this transition in its genetic and phyletic implication that the writers were led to discuss the problem in a paper read before the Boston meetings of the American Botanical Society (1947), titled "The Congeneric Aspects of *Lesquerella Kingii* and *Physaria Geyeri.*"

Intergradation between *Physaria Geyeri* and *Lesquerella* has long been recognized. Rollins (1950, p. 46) concluded that "the assumed gap between these genera [*Lesquerella* and *Physaria*] has been completely closed insofar as the morphology of the various entities involved is concerned. There remains the slender evi-

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[1] Since this paper was submitted to the editors, Doctor Jakowska has published two studies, one of which further discusses the nuclear morphology of *Physaria australis, P. Geyeri,* and *Lesquerella Forwoodii;* and earlier, the other which describes trichome development and morphology of the same species.

Jakowska, S. The trichomes of *Physaria Geyeri, Physaria australis,* and *Lesquerella Forwoodii:* development and morphology. Bull. Torrey Club 76: 177-195. 1949.

Idem. The resting nucleus in *Physaria* and *Lesquerella.* Bull. Torrey Club 78: 221–226. 1951.

dence from cytology which is, to say the least, incomplete." In continuing discussion, Rollins has emphasized the haploid chromosome numbers known in *Lesquerella* to be 5, 6, 8, and 9 (to us, a most engaging aneuploid series), while in three species of *Physaria* the number is 4. In conformity with this pattern, observations of Doctor Jakowska[1] indicate that the diploid number for *Physaria australis* and *P. Geyeri* is 8, and for *Lesquerella Forwoodii,* 10.

The somatic chromosomes of *Physaria australis* are shown by her to be relatively massive, those of *P. Geyeri* to be small and apparently structurally similar to those of *Lesquerella Forwoodii.* Though there is little evidence, we wonder whether in this group chromosome morphology may not be more significant than chromosome number, and whether 4 may not also be basic in the aneuploid chromosome series for *Lesquerella.* If so, it is possible that *Physaria Geyeri* (and perhaps also *P. oregana*) may be generically allied with *Lesquerella,* most closely to *L. Kingii,* and not with *Physaria.*

Physaria cordiformis was recently proposed by Rollins (1950) based on a collection (*Alexander & Kellogg 4393*) from Mineral County, Nevada, at 9300 feet elevation. The type is a vigorous annual with numerous profusely flowering and fruiting branches, definitely lesquerelloid in habit. Rollins described this species as improbably a perennial, but some plants of the population certainly persist for more than one growing season. The pods are obcordate and obcompressed, the largest about 4 mm. long and 5 mm. broad. They are possibly a little past maturity, since the walls apparently were more inflated but have become partly or strongly deflated, often leaving a ridge in evidence of the more rigid replum. The isotype (University of California Herbarium no. *736089*) consists of three specimens. The largest is the most luxuriant of the type series. It is nearly identical with the type specimen, except that the pods are not so strongly obcompressed, but are more conspicuously inflated much as in *Lesquerella hemiphysaria.* A comparison of the type of *Physaria cordiformis* with the series of plants collected at higher altitudes in the Toiyabe, Toquima, and Monitor ranges, Nye County, Nevada, and the White Mountains, Mono County, California, demonstrates that all are, without doubt, contaxic.

The paratypes of *Physaria cordiformis* (*Holmgren 829* and *Ripley & Barneby 6200*) are low-altitude plants. They display a more lax habit, and have larger leaves and larger broader pods, 6 mm. long and 7 mm. wide, strongly flattened, this obviously accentuated by pressing and drying.

KEY TO THE VARIETIES OF LESQUERELLA KINGII

Plants lax, few branched; leaves usually broadly spathulate (sometimes narrowly so in var. *nevadensis*); pods 3–5 mm. long, 4–6 mm. broad.

Pods subglobose to obcordate and obcompressed, inflated, usually not conspicuously compressed, the sinus narrow; plants of intermediate latitudes .... 1. *L. Kingii* var. *Kingii*

Pods obcordate to obcompressed, conspicuously flattened but also somewhat inflated, the sinus relatively broad; plants of lower altitudes ..... 2. *L. Kingii* var. *nevadensis*

Plants more closely rosette-forming; leaves more often narrowly spathulate to oblanceolate; pods 2–4 mm. long, 2–5 mm. broad, subglobose or obcordate and obcompressed, the sinus relatively narrow, or the pod truncate or merely obtuse; plants of high altitudes .... 3. *L. Kingii* var. *cordiformis*

1. Lesquerella Kingii var. **Kingii**. *Vesicaria Kingii* S. Wats. Proc. Am. Acad. 23: 251. 1885, as to type.

Type. West Humboldt Mountains, Pershing County, Nevada, June, 1868, *S. Watson 82* (Gray Herbarium; isotype, New York Botanical Garden).

Distribution. Foothills and slopes, 6500 to 9500 feet altitude, White Pine and Pershing counties south to Lincoln and Nye counties, Nevada.

Representative specimens. Nevada. Esmeralda County: Cherry Creek Pass, Quinn Canyon Range, *Maguire & Holmgren 25533;* pods spheroid to mostly obovate, 3 miles west of Cherry Creek Summit, *Maguire & Holmgren 25548.* Lander County: Kingston Canyon, *Goodner & Henning 195.* Nye County: Mohawk Canyon, 7500 feet, Toiyabe Range, *Maguire & Holmgren 25429;* pods truncate or slightly retuse, Mohawk Canyon, *Maguire & Holmgren 25685;* pods somewhat flattened contrary to the partition, rounded, truncate or slightly retuse, Indian Valley, 7000 feet, *Maguire & Holmgren 25671;* pods truncate to retuse, Stewart Creek, 9500 feet, *Maguire & Holmgren 25915.* Pershing County: West Humboldt Mountains, silicles globose, above Unionville, 6600 feet, *Ripley & Barneby 5620.* White Pine County: calcareous gravel, 6 miles north of Ely, *Ripley & Barneby 6271A.*

The collection by Ripley and Barneby (no. *5620*) from the type locality, though immature, helps to fix the identity of the still-less-mature type (*Watson 82*). There now remains no reasonable doubt that the type collection represents the widespread middle-altitude phase of the species. Indeed, no related species is known to occur in the area. *Lesquerella latifolia* (with which *L. Kingii* merges in Lincoln County, Nevada) with pods longer than broad, occurs to the south in the region transitional to the Mohave Desert; *L. Barnebyi,* with short obovate non-obcordate pods and different habit, is known only from White Pine County.

2. Lesquerella Kingii var. **nevadensis** var. nov. Plantae annuae vel subperennes; caulibus prostratis vel procumbentibus;

laminis foliorum oblanceolatis vel rhomboideis, aliquando cum dentibus lateralibus; siliculis 4–6 (7) mm. latis, 3–5 mm. longis, obcompressis, obcordatis vel late obovatis, truncatis, aliquantum inflatis; sinibus latis; stylis 3.0–4.5 (5.0) mm. longis.

Type. Frequent, sandy, gravelly soil, associated with *Artemisia tridentata,* bench 3 miles east of Reese River Range Station, road to Mohawk Canyon, Toiyabe Range, 6800 feet altitude, Nye County, Nevada, June 14, 1945, *Maguire & Holmgren 25418* (New York Botanical Garden; isotype, Utah State Agricultural College).

Distribution. Foothills and valleys, 5000 to 6800 feet altitude, Nye County, Nevada to Twin Falls County, Idaho.

Representative specimens. NEVADA. Elko County: 30 miles east of Wells, *Train 3665;* 55 miles south of Elko, *Holmgren 829* (paratype of *Physaria cordiformis*); 10 miles north of Currie, *Ripley & Barneby 6445* (canescent form); Pequot Range, *Ripley & Barneby 4611.* Eureka County: Lone Mountain 18 miles west of Eureka, *Ripley & Barneby 6220* (paratype of *Physaria cordiformis*). Nye County: Toiyabe National Forest, *Maguire & Holmgren 25418, 25430, 25474, 25684.* Collections by Ripley and Barneby from 22 miles north of Wells, Elko County, Nevada (*6461*), and from 10 miles south of Rogers, Twin Falls, Idaho (*6467*) are part of a series connecting var. *nevadensis* with *Physaria Geyeri;* but they are more silimar to typical plants of the latter.

The variable var. *nevadensis* on the one hand passes freely into var. *Kingii* and on the other approaches or even transcends (through *Physaria Geyeri*) the line between *Lesquerella* and *Physaria.* The varietal epithet was adopted from a name on the label of *Ripley & Barneby 6220.*

3. LESQUERELLA KINGII var. **cordiformis** (Rollins) stat. nov. *Physaria cordiformis* Rollins, Contr. Gray Herb. 171: 47. 1950.

Densely rosette-forming with numerous procumbent densely flowering branches; basal leaves broadly to narrowly spathulate or oblanceolate; pods obcordate and obcompressed to obovate or globose, usually inflated, often rounded, 2–4 mm. long, 2–5 mm. broad; style 3–5 mm. long.

Type. In road, branch of Cat Creek, 9300 feet altitude, Wassuk Range, Mineral County, Nevada, July 8, 1945, *Annie M. Alexander & Louise Kellogg 4393.* Gray Herbarium; isotype, University of California no. *736089.*

Representative specimens. CALIFORNIA. Mono County, White Mountains: Blank Mountain, 10,500 feet, *Maguire & Holmgren 26052;* flowers white, Crooked Creek, *Maguire & Holmgren 26056, 26124;* flowers yellow, 12,000 feet, *Maguire & Holmgren 26084;* Campito Meadow, 10,800 feet, *Maguire & Holmgren 26120.* Nevada, Mineral County: Cat Creek, Wassuk Range, 9300 feet, *Alexander & Kellogg 4393* (type of *Physaria cordiformis* Rollins); Mt. Montgomery Pass, 8600 feet, *Train 4006.* Nye County: Barley

Creek, Monitor Range, 9800 feet, *Maguire & Holmgren 25693;* Pine Creek, Toquima Range, 10,000 feet, *Maguire & Holmgren 25824.*

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Utah State Agricultural College, Logan.

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AQUATIC PLANTS IN OZETTE LAKE, WASHINGTON

W. C. Muenscher

Many of the smaller glacial lakes of the lowlands of western Washington occupy partly filled depressions with peaty margins and soft oozy bottoms which do not provide a favorable substrate for many rooted aquatic plants. Ozette Lake, which lies within two miles of the Pacific Ocean in the Olympic Peninsula, Clallam County, differs in that it has a firm sandy or stony bottom and several shallow bays. The areas which are somewhat protected from the direct action of the prevailing westerly winds support a luxuriant aquatic vegetation of both emersed and submersed species. That the aquatics of Ozette Lake have not been neglected as much as those of most lakes is attested by the collections of I. C. Otis, J. W. Thompson, and G. N. Jones, cited by Jones (1936) in his survey of the Olympic Peninsula flora.

Scheffer and Hotchkiss (1945) have compared the distribution of fifty-one species of aquatic plants from ten glacial lakes in western Washington. They list only twenty-two species from Ozette Lake. All of these except *Scirpus validus* Vahl were observed in July, 1950. The following species are additions to their list for Ozette Lake:

*Lycopodium inundatum L. On sandy boggy shore near the outlet.

Isoetes echinospora Dur. var. Braunii (Dur.) Engelm.

Isoetes Piperi A. A. Eaton.

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* Not reported by Jones (1936) from the Olympic Peninsula.

*POTAMOGETON AMPLIFOLIUS Tuckerm. In deep water off the east shore.

*ALISMA PLANTAGO-AQUATICA L.

GLYCERIA GRANDIS Wats.

GLYCERIA PAUCIFLORA Presl.

CAREX OEDERI Retz. var. VIRIDULA (Michx.) Kük.

CAREX ROSTRATA Stokes var. UTRICULOSA (Boott.) Bailey.

CAREX MERTENSII Prescott.

CAREX KELLOGGII Boott.

CAREX CUSICKII Mack.

CAREX LIMOSA L.

CAREX LYNGBEII Hornem.

CAREX OBNUPTA Bailey.

CAREX PIPERI Mack.

DULICHIUM ARUNDINACEUM (L.) Britt.

ELEOCHARIS PALUSTRIS (L.) R. & S.

ELEOCHARIS OBTUSA (Willd.) Schutt.

SCIRPUS ACUTUS Muhl. This common emersed species extending from shore to deep water is probably what has been reported as *S. validus* Vahl by Scheffer and Hotchkiss. Along the east shore extreme specimens were measured which had a height of sixteen feet.

LEMNA MINOR L.

SPIRODELA POLYRHIZA (L.) Schleid.

JUNCUS FILIFORMIS L.

*IRIS PSEUDACORUS L. In shallow water near shore of Garden Island; probably introduced.

*NYMPHAEA TUBEROSA Paine. In a shallow bay off the east shore of Garden Island; probably introduced.

RANUNCULUS REPTANS L. var. OVALIS (Bigel.) T. & G.

SUBULARIA AQUATICA L.

POTENTILLA PACIFICA Howell.

POTENTILLA PALUSTRIS Scop.

MYRIOPHYLLUM EXALBESCENS Fern.

LILAEOPSIS OCCIDENTALIS C. & R.

OENANTHE SARMENTOSA Presl.

VERONICA SCUTELLATA L.

VERONICA AMERICANA Schwein.

*UTRICULARIA INTERMEDIA Hayne. Intermingled with *U. vulgaris* among *Menyanthes trifoliata* in shallow water, Swan Bay.

LOBELIA DORTMANNA L. In shallow water the flowering stems of this plant grow spirally coiled about the stems of *Equisetum limosum;* probably due to wind action.

*BIDENS BECKII L. Submerged in four to five feet of water.

Not all of these plants are known to be a source of food for waterfowl, but many of them are eaten by waterfowl and have been among those plants so reported from other lakes of the Pacific Northwest (Scheffer and Hotchkiss, 1945). It is believed that the additional species here reported must be considered if the plant-food resources for waterfowl available in Ozette Lake are to be accurately evaluated. Its strategic location, as the most westerly freshwater lake in continental United States, certainly is not overlooked entirely by migrating waterfowl. If the value of Ozette Lake is recognized and the removal of the adjacent coniferous forest, which is likely to take place in the next decade or so, is properly managed, the plant-food potentialities may be expected to increase. On the other hand, if the forest-removal operations are carried on under conditions which permit excessive silting or accumulation of quantities of bark and waste wood in the lake then many of the shallow areas supporting aquatic plants may become unproductive.

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A NEW HAPLOPAPPUS FROM NEW MEXICO

ARTHUR CRONQUIST

Haplopappus microcephalus sp. nov. Planta perennis, glabra vel subglabra, ut videtur suffrutescens, caulibus pluribus ad 5 cm. altis, foliis firmis oblanceolatis trinervatis integris vel subintegris, imis oblanceolatis 2–4 cm. longis 2–3.5 mm. latis, caulinis similibus sed minoribus; capitula plura in inflorescentia corymbiformi, involucris 6–8 mm. altis turbinato-obconicis, bracteis imbricatis plurimis caudato-attenuatis, radiis flavis inconspicuis 2.5–3.0 mm. longis ca. 9–12, corollis disci fertilibus 4.3–4.7 mm. longis ca. 7–14, appendicibus styli anguste lanceolato-triangularibus, setis pappi ca. 30 inaequalibus albidis.

Perennial, glabrous or nearly so, apparently mat-forming and suffrutescent as in *H. acaulis;* stems several, about 5 cm. tall; basal leaves numerous, firm, 2–4 cm. long, 2–3.5 mm. wide, oblanceolate, acute, subpetiolate, entire or with an occasional small tooth, 3-nerved, the nerves resinous above; cauline leaves several, similar but somewhat smaller; heads several or rather many (up to 30 or more) in a condensed, rather flat-topped, corymbiform inflorescence; involucre 6–8 mm. high, turbinate-obconic, its firm, chartaceous bracts imbricate in several series, the outer gradually caudate-attenuate, the middle ones abruptly so, the innermost merely sharp-pointed; rays inconspicuous, yellow, about 2.5–3.0 mm. long (counted as 9, 10, and 12 on three heads), fertile; disk-corollas yellow, about 4.3–4.7 mm. long, with short lobes, fertile, counted on three heads as 7, 13, and 14; style-appendages about 0.8 mm. long, narrowly lance-triangular, twice as long as the stigmatic portion of the branches; pappus of about 30 markedly unequal white bristles.

Type. Crevices of granite rocks in open yellow pine forest, altitude 8200 feet, Tres Piedras, Taos County, New Mexico, July 8, 1950, *Ripley* and *Barneby 10316;* just coming into bloom (State College of Washington Herbarium No. 155825).

The affinities of this species are obscure. *Haplopappus microcephalus* bears a strong habital resemblance to *Petradoria,* but the heads are obviously quite different, and it lacks the technical characters by which that closely allied genus is distinguished from *Haplopappus* (vertically aligned phyllaries, sterile disk-flowers). There is also some resemblance, both habitally and technically, to *H. acaulis,* but that species, as well as the whole section to which it belongs, has solitary, much more numerously flowered heads. In Hall's monograph, *H. microcephalus* would key to the section *Hesperodoria,* and it might indeed be possible to see a distant relationship with *H. scopulorum* of that section, but the obtuse phyllaries, discoid heads, and definitely shrubby habit of that species preclude the assumption of any close relationship. I know of no other possible close allies of the new species, which is here confidently proposed.

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REVIEW

Maize in the Great Herbals. By John J. Finan with a foreword by Edgar Anderson. Chronica Botanica Co., Waltham, Mass. xvi + 149–191 pp. $3.00 (San Francisco dealer: J. W. Stacey, Inc.)

This work, first published in the Annals of the Missouri Botanical Garden (35: 149–191, 1948), has now been reprinted in a handsomely-bound limited edition with a foreword by Edgar Anderson. By bringing together in a compact form the many scattered references to maize in the writings of the early explorers and the herbalists, Mr. Finan has performed an invaluable service to those interested in maize itself as well as to those interested in the history and origin of crop plants. It is fortunate that one of the very few large collections of herbals in this country is located at a center of active research in maize, the Missouri Botanical Garden. Due to this happy circumstance and to the cooperation of experts in modern and classic languages and in art history, Mr. Finan has produced a critical and well annotated account of the early history of maize.

The first section is an account of maize in America in the period just after the conquest, pieced together from many, but by no means all, of the accounts of the early explorers. While there is a surprisingly large amount of material available on the importance and uses of maize in Indian economy, there is a curious lack of information on the different forms and varieties grown throughout North and South America. On the other hand, the herbalists gave detailed descriptions of the plant supplemented by woodcuts, from which it is possible to obtain a fair idea of the varieties grown in Europe subsequent to the conquest. However, in spite of its novelty, maize was first described in the herbal of Bock (1539), some forty years after the discovery of the New World and its possible introduction into Europe. Furthermore, it was not until thirty years later that its American origin was recognized by the herbalists. As in the case of so many American plants of the time, its place of origin was thought to be India or Turkey.

By a careful study of the texts and particularly of the illustrations, Finan has discovered that the maize plants described by the early herbalists resemble northern flint varieties, which are now found in Eastern North America. Lobelius (1576) was the first to describe a second type with numerous prop roots at the lower nodes. He called this second type Indian corn to distinguish it from the earlier-described Turkish-Corn, which did not have the conspicuous prop roots. Tropical varieties characteristically develop such prop roots when moved to high latitudes. Thus, the second variety could very well have come from tropical America. However, the origin of the first type still remains a puzzle. The herbalists considered it to be of oriental origin. Finan suggests two possibilities: first, it may have been introduced into Europe from eastern North America by early English or still earlier Norse explorers, or secondly, it may have been a Caribbean variety that does not develop the characteristic prop roots. As yet no such Caribbean variety has been discovered. Thus another puzzle has been added to the many already existing concerning the origin and distribution of this important food crop.

The value of this volume is considerably enhanced by tables of names, places of origin and kernel colors recorded in the herbals. In particular, there is an extended discussion of the woodcuts used as illustrations together with a table showing which are originals and which are copies. JAMES A. JENKINS, Division of Genetics, University of California, Berkeley.